Review

Emotional, behavioral and cognitive mechanisms in rehabilitation of romantic love neuro-cognitive process

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Accepted 25 November, 2013

Neuro-cognitive assessment of romantic love is confined. The identifying theories and mechanisms involved in these complex feelings helps to better understanding of its neurobiology. The aim of this study is to investigate systemic emotional, behavioral, and cognitive mechanisms in rehabilitation of romantic love neuro-cognitive processes. It is not surprising that activities occur in brain areas which are also active in other emotional states but stimulated activity pattern is unique here. While expression and experience of love is very broad and different, its study can easily be far from the advantage of effective and powerful magnifier which researchers provide. Multi-dimensional nature of this feeling forces researchers to use always theorizing and research methods and combine different levels of analysis in a way that pay attention to fundamental aspects of love from personal perspectives and so utilize greater integration of multiple disciplines for assessing this feeling. Previous studies indicate that scientific investment should be in a right direction to develop understanding toward this outstanding individual phenomenon and it can be used as a solution in emotion rehabilitation.

Keywords: rehabilitation, romantic love, emotional, behavioral and cognitive mechanisms

INTRODUCTION

Cognitive rehabilitation therapy (CRT), a group of designed techniques used for the expansion of cognitive domains. CRT is the science of restoring cognitive processing and learning compensatory strategies which affects the molecular and cellular recovery by integration of behavioral and cognitive changes. The promotion of rehabilitation science of cognitive neurosciences has made it a priority in a full range of effected interventional procedures. It is possible to achieve the desired goals in the chain of theoretical and experimental sciences on the basis of behavioral interventions which is made of cognitive neuroscience, psychology, physiology, pharmacology, medical imaging, and other medical disciplines. Cognitive impairment is a huge health challenge. Our approach to CRT is based on the assumption that treatment would be the most effective way when focusing on the cognitive sub-systems and these are also affected by other aspects of life as a patient emotions, nutrition, health, stress, and social performance. Intervention in the passive skills can lead to neuro-cognitive rehabilitation that includes designed experience on the basis of nerve, brain function and structure. A failure of cognitive or brain processing is a disorder. Nerve reconstruction in CRT is done through neuroplastisity, reorganization of damaged cortex, morphological and physiological responses. This method is the ability to change the neuro-cognitive processes used as a factor in emotional rehabilitation. Romantic love, a complex feeling including cognitive, emotional and behavioral components is one of the most powerful emotional states known, which was the inspiration of some great human achievements (Fisher, 1998), (Bartels and Zeki, 2000), (Panksepp, 1998). The main characteristic of love is paying attention to one person.
and visual input has the most important role in romantic love persistence and vigilance.

There are so many ways to study love which are not surprising due to its multi-dimensional structure. It seems there is a missing piece in the middle range of theorizing and research. Related researches of love have been done through three methods. First, researches were mostly about binary nature of love. Second, love was considered beyond couples as a network phenomenon. Third, researches which combine different level of analysis in a way that paying attention to fundamental aspects of love from personal perspectives. At the same time, these researches encompass broader social impacts. So, greater integration of multiple disciplines is required. In the previous studies, some lists of main variables and cognitive types of love have been discussed. Demonstration of expanded terms of love and lack of integrated studies do not provide clear research agenda for acquiring knowledge about this valuable concept. Hence, cognitive assessments are required in this area (Zarghi et al. 2011, 2012). The aim of this study is to investigate in systemic emotional, behavioral, and cognitive mechanisms in rehabilitation of romantic love neuro-cognitive processes.

Theories associated with emotional and behavioral mechanisms in romantic love

Distinction between love and very close concepts such as liking and attraction

One of the first tasks in studies related to romantic love is distinguishing between love and associated concepts such as liking and attraction. So, first we discuss about conceptual distinctions. In some typologies, love has been differentiated from a feeling with less intensity such as liking. Many years ago researchers (Rubin, 1970) separated like from love and created a scale for their measuring. Loving includes subjects such as similarity, respect and positive evaluation. Love dimensions were independence, compassion and exclusiveness. They found that love and like have moderate relationship with each other and distinction between is still under study (Lamm and Wiesman, 1997). However, like is barely evaluated in relationship researches. Love also has been separated from attraction. A main field in the area of social cognition appeared in 20th century and there was a kind of emphasis on love which was interpreted as attraction (Byrne, 1971). Attraction is having positive attitude toward others (Berscheid, 1985) and hence it is related to love with less intensity. Also, love is compared with other investigating structures of “relationships pulse” including commitment, respect and intimacy (Orbuch and Sprecher). Of these scales “pulse” is often considered as an emotional love. In this way, emotional love is different from companionship love (Walster and Walster, 1978).

Companionship love is a feeling between two persons when marrying while emotional love is “the intense desire to join another person”, and the mutual love is accompanied with “so much happiness and joy”. If a two-way love is not achieved the result would be “anxiety and disappointment” (Hatfield and Rapson, 1993). Therefore, emotional intensity in emotional love is more than companionship love.

Engagement, long-term relationships, increase of self-esteem and greater understanding

Other researchers (Berscheid and Walster, 1974) have assessed the emotional intensity of emotional love (from emotion to emotional love) by using Schachter two-component theory (Schachter, 1964). It was argued that emotional love is accompanied with more physiological arousal intense. Dutton, Aron (Dutton and Aron) and colleagues (White et al., 1981) have distinguished emotional love from companionship love in terms of elegance and its relation with sexuality. It showed that emotional love appears less stable but more severe in sexuality. There are some evidences for theoretical differences between emotional love (often is assessed by Hatfield and Sprecher emotional love scales (Hatfield and Sprecher) and companionship love (often is assessed by Rubin love scales (Rubin, 1970). However, these differences are not substantial. For example, both emotional and companionship love are related with experiencing different positive feelings in a relationship and there is no place for negative feelings (Sprecher and Regan, 1998), (Regan et al. 1998). While, originally it was supposed that emotional love is first formed in relationships and then is converted to companionship love (Walster and Walster, 1978) yet both kinds of love are noted in romantic love (Hendrick, 1993), (Hatfield, 1998). This combination may confirm long-term relationships claims such as marriage (Noller, 1996). The dual distinction between companionship and emotional love is similar to distinction between love making and loving (Meyers and Berscheid, 1997). Being in love is stronger than common making love and it is accompanied with sexual desire (Regan et al. 1998), (Regan, 1998), increased self-esteem (Hendrick and Hendrick, 1998), and self understanding (Aron et al. 1996) especially in mutual love. In fact, “falling in love” process which is a common social phenomenon can indicate “being in love” process in emotional peak.

Typologies of love and their relationship with personality

John Lee (Lee, 1973) designed love style typologies in his studies based on interviews with married people. These styles or love types are passionate love (intense
passionate love), ludus (game-playing love), storage (friendship love), pragma (practical love), mania (obsessive, dependent love) and agape (selfless love). Although early researches of love styles had been focused on developing all scales and establishing psychometric properties, Hendrick and Hendrick, 1986, Hendrick et al., 1984) new researches are about how to predict the end of a relationship by love styles and how to test their relations with individuals' personality (Hendrick and Hendrick, 1992). Some of love styles at least based on the content of used items for assessment (Hendrick et al., 1984) have more emotional intensity than others. In fact, love styles have been described according to their degree of emotional intensity. Passionate love and mania have the most emotional intensity, agape is moderate, ludus, storage and pragma are low in emotional intensity scale. However, love styles generally reflect more "love as a feeling" than "love as a emotional peak".

Commitment, intimacy, understanding, compassion and support in relationships

Sternberg (Sternberg, 1988) considers three main components for love: intimacy, passion and commitment (it should be considered in a triangle shape). Each component (triangle side) varies from down to up in a way that it creates different numbers of shapes and sizes of triangles. Furthermore, passion, commitment and intimacy may be similar between couples and different between person's current and ideal relationship. Intimacy is an emotional or sentimental component which is attributed to affection, understanding, compassion, protection and communication. Passion is a motive which is known by physical attractiveness and arousal. Commitment is cognitive and refers to decision of staying in a relationship and keeping it. Although intimacy is described as emotional component, both intimacy and passion have emotional dimensions as reflected in scale items contents of these different components. Model of triangular love involves eight types of love from lack of love (no intimacy, passion and commitment) to a desired end of love (a high degree of three components). Emotional intensity of love types including passion and intimacy can be considered higher than others. These types involve romantic love (intimacy with passion) and desired end of love. Except lack of love, hollow love is accompanied with lowest degree of emotions which only involves commitment. However, lack of deep measurement for this specialized love typology prevents the research from conducting because of diagnosis problems of credibility (Aron et al., 2006). Sternberg (Sternberg, 1988) presented a new approach to love. This perspective has a social interpretation view toward love and expresses love as a story. Individuals make love stories based on social experiences with their partner, media and others try to implement these love stories in their own relations. So, every story forms partner selection and final route of a relationship. Although people may have multiple love stories, they prefer some narratives to another. Common themes include couples who enter a close relationship over time while always are careful about their relationship and couples who are always in conflict with each other. Sternberg identified popular love stories in which feeling is likely a part of the issue. These stories are: addiction story (severe affection and eager / anxious), cultivate story (a connection requires affection), horrible stories (a relationship accompanying by couple's threat and intimidation) and war stories (love is chains of battles). Love story approach is a newcomer matter in classification schema of love and it deserves more experimental tests. One significant question is relationship and difference measures of many kinds of love in this vision by previous schemes in this area. A general difference unlike previous approaches is that this new concept is related to two inter-related roles of each partner's love.

Feeling as a factor in behavioral and social supportive

Other scholars have focused on the depth of a certain kind of love which involves unrequited love (Baumeister et al., 1993), limerence or any kind of intensive love (Tennov, 1979), passion (Regan and Berscheid, 1999), friendship love (Grote and Frieze, 1994), companionship love (Sprecher and Fehr, 2005) and love as a subject for developing relationships and behavior (Bowbly, 1973). Despite there may be similarities between various types of love; they include correlations and unique implications. For instance, one-way love can lead to low self-esteem (Baumeister et al., 1993) which is not the feature of other types of love. In particular, companionship love can be a sign of participation in social-supportive behaviors (Sprecher and Fehr, 2005). There are limited researches on cultural and sub-cultural differences in various types of love and its experiences. Some scholars have come to this end that there is an evidence for cultural universality of romantic love (Hatfield and Rapson, 1993). Researches also indicate differences between race and social class (Contreras et al., 1996). Similarly, there are some balanced gender differences in love styles. For example, passion and ludus levels are more in men while women have more tendencies toward states of storage, pragma and mania (Hendrick and Hendrick, 1986). Certain general theories of human behavior are related to love studies. For example, self-evolution theory (Aron, 1996) states that individuals make love for getting into a relationship with another specific person in order to put him into their souls and evolutionary experiences. Furthermore, dependence theory (Bartholomew, 1990); Bowlby (Bowlby, 1973); Hazan and Shaver (Hazan and Shaver, 1987) is a
development theory which is applied for love. They argue that adult romantic love is retrieved from human dependency, care and sexual system. Adult relationships attachment styles are different. This is partly dependent on constructive experiences of caregiver. Finally, another general theory which is at least used indirectly about love is behavior evolution theory (Buss, 1988). This view is focused on possible evolution way of attitudes and feelings and their use as developmental and reproductive values during time. The fiery love might have help “species of male and female in reproduction” and companionship love might have provided “experience of relationship survival and its related reproduction”. This theory also predicts sexual differences in preferred love partner and used mating strategies to attract love partner. “Love acts” (shown behaviors to one person) are involved in reproduction because of their relationship. Theories of related concepts also help interpretation of one aspect of love such as motivation for entering into a relationship.

Goode (Goode, 1959) defines love as a deep emotional attachment in “theoretical importance of love”. He claims that this psychological cathexis has a significant importance in phenomena investigations at social level. Goode studied power of love and its capacity in disrupting social structures, class system and lineage relationships within the community. Selection of casual partner can cause fundamental changes in current social structures of society and classification system. Kemper (Kemper, 1987) argues that love is a feeling of social relationship and it is composed of two elements: power and status. Simultaneous love is both experience of emotional coordination and desire of compatibility with beloved status. Love making is basically different from liking someone because liking someone is a feeling which is stimulated by rewards or states that we get from another one. Romantic love is when lovers experience relatively high levels of state / emotion and love in their relationship (Kemper, 1997). In romantic love, lovers show high levels of emotional affairs and severe pain for reinforced fear of losing relationship which involves one side of relation. So, inconsistency of love relates to both its voluntary and involuntary characteristic and apparently out of individuals’ controlling feature.

Networks can influence all aspects of love. First, if a couple wants to love each other, they must meet each other. Social networks form an environment which individuals tend to communicate with their probable beloved person (Goode, 1959). Social networks may affect on the searching kind of love or person’s opinion for being an experience. When a relation starts, direct social position of couples influences constantly on their love. Social network protection and confirmation of couples predicts increased feelings of love and its durability over time (Felmlee et al., 1990), (Sprecher and Felmlee, 2000). Why should social environment increase love feeling and its durability? Friends and supporter family bestows to couples a safe and ready nest, a source of emotional support which makes the opportunity of growing. Some couples need practical and financial helps. Emotional advice and support are also necessary for maintaining relationships. On the other hand, it is accepted that in some cases network opposition strengthens couple’s relationship instead of destroying feeling of love between partners. General role of network support and opposition in formation of a controversial love is not so clear. A couple’s relationship may not last forever, at this time a deficiency can be clear according to nature of social ties (Lofland, 1982). Little research has been done in this regard but social environment of individuals may affect measured emotional path. At the end, almost no scientific investigation has been conducted on interference, strengthen or change of experienced love by romantic couples and vice versa for close non-romantic relationship by others. In focusing on adults’ romantic love, couples of opposite sex are more pronounced in love researches rather than families and other members of the network. Furthermore, these couples and social-family dynamics are different in cultures; so a spread research is needed for addressing these issues.

**Neuro-cognitive mechanisms in Romantic Love**

It seems that love can help to emotion rehabilitation. One of the goals of this study was to investigate systemic cognitive mechanisms in rehabilitation of romantic love neuro-cognitive processes. Romantic love can change the neuro-cognitive processes to be used in emotion restructuring. It can be used as a way of empowering feeling to be loved. Emotional neural pathways overlap with other cognitive domains and reinforce these pathways help to strengthen the cognitive processes so with these changes can affect a person’s quality of life. Cortical and sub-cortical brain structures are involved in romantic love. Insula is also related to several emotional performances and its damage results in serious emotional consequences including interpretation of visual data (Flynn et al., 1999). Imaging studies confine negative emotional experiences in the anterior insula which is different from the middle insula (Flynn et al., 1999). Previous studies indicate that attractive unfamiliar faces had a positive relationship with flow velocity (Nakamura et al., 1999), an area which apparently does not overlap with other parts. Large anterior cingulate cortex includes several distinct and main components (Devinsky et al., 1995). Of course, several sub-sectors of it play an important role in emotional functions. In previous imaging researches, different emotions were attributed to anterior cingulate and various sub-sectors were activated. Especially anterior cingulate cortex includes some parts suggesting happy emotional states, self-attention and in particular social interactions involving assessing of emotions and mental states of ones own.
and others (Frith et al., 1999), (Devinsky et al., 1995).
Caudate nucleus and putamen were observed in investigating positive emotions of two activated subcortical zones (Morris et al., 1996; Breiter et al., 1997; Nakamura et al., 1999; Lane et al., 1997; Stoleru et al., 1999). These areas are also activated by negative emotions (George et al., 1995; Lane et al., 1997; Teasdale et al., 1999) and both of them are a part of extra pyramidal motor system. Motor imagery, mental rotation and motor execution usually do not activate any of these two structures (Decety and Grezes, 1999). Totally these results require a reassessment of putamen and caudate nucleus roles in emotional states as some parts of extra pyramidal motor system (Koepp et al., 1998).

Happiness is related to inactivation of right prefrontal cortex, bilateral and temporal parietal (George et al., 1995). Depression and sadness are associated with activation of certain cortical areas, particularly, the right prefrontal cortex (Beauregard et al., 1998) which its artificial inactivation by transcranial magnetic stimulation has confirmed the successful treatment of depression (Menkes et al., 1992). Posterior cingulate cortex is usually an active area in examination of emotion (Maddock, 1999), but its function is not exactly understood. Inactivation of amygdaloid area is interestingly important, because its activity is related to fear, distress and aggression. It is suspected that it is involved in emotional learning (LeDoux, 1996).

Researches suggest that amygdaloid area is more active when experiencing positive feelings during visiting friends and lovers (Morris et al., 1996).

Sexual arousal is always accompanied by romantic love. Sexual arousal (Stoleru et al., 1999), (Rauch et al., 1999) happens in two active areas, one in left nucleus caudate and right insula and the other in globus pallidus (Rauch et al., 1999). Also, it is inactivated in posterior cingulate cortex (Stoleru et al. 1999) and right hemisphere (Rauch et al. 1999). Stimulated areas in inferior cingulate cortex (Bartels and Zeki, 1999; Breiter et al., 1997) in resulted euphoria of cocaine and opiodic materials are insula, caudate nucleus and putamen (Breiter et al. 1997) which are similar to stimulated areas in romantic love (Figure 1).

This suggests a close relationship between romantic love and happiness state. Although sexual interest and romantic love often occur together, these two categories are essentially different inner experiences which their neuro-biological substrates are different, too. The basis of these differences is evolutionary origin of each experience. Sexual desire issues happen in regard to partner selection. Oxytocin impact on love and sexual desire is the answer to why there is a bilateral relationship between love and desire in women more than men. Since most of the researches in neuro-
biological substrates of sexual desire and emotional dependency was done about animals, systemic review of coordinated biological, behavioral and cognitive trends are prior in further investigations which form experiences of love and desire among humans. Researches about love and passion have focused on neuro-biological substrates of behaviors and distinctive cognitions. Although little related research has been done in this area about humans, a range of evidence shows that specified experimental differences between love and passion may be attributed to impacts of their neuro-chemical differences. For example, estrogens and androgens (Fisher, 1998) directly mediate sexual desire. However, hormones are not mediating emotional constraint information. In contrast, researches on animal show that distinctive emotions and behaviors are related to formation of affection through basic environment "reward" in the mammalian brain origin. These include coordinated action of endogenous opioid matters, catecholamine and neuropeptides such as oxytocin. These neuro-chemical materials regulate a range of emotional, cognitive, behavioral and physiological trends which facilitate social links by promotion and nourishment of qualified communications between certain social partners and inherent feeling (Schachter, 1964).

Passion creates feelings of euphoria and elation in humans. Also, it is followed by feelings of exhilaration and happiness which are often intolerable and absolutely indescribable. The areas which are activated in response to romantic feelings are largely cooperating with those areas of brain containing high concentrations of neuro-modulator in connection with states such as reward, desire, addiction and euphoria. Like two other neuro-modulators, oxytocin and vasopressin which are related to romantic love, dopamine is also released by hypothalamus and acts as a connector between nervous and endocrine systems. When exogenous opioid drugs like cocaine are used (exactly when these materials were swallowed), similar areas became activated. Of course, it should be mentioned that these materials induce a state of euphoria spontaneously. Dopamine release puts the person in a state of euphoria and it seems that dopamine has a close relationship not only with relationship formations but also with sexual relations. It is worth notifying that these relations occur subsequently after euphoria and rewarding states. By increasing the amount of dopamine, another neuro-modulator named serotonin decreases (HT-5 or hydroxy tryptamine -5) which is related to mood (Zeki, 2007). Some studies show decrease in serotonin amount in the early stages of romantic love which its extent is common in patients with practical obsessions. After all it should be said that love is a kind of thought obsession. Thinking usually does not act well in the early stages of romantic love. It seems that these early stages are related to another material. It has been approved that neuro-development factor is more in those who are newly in love than those who are not, people who are in a strong relationship and even those who are in love for a long time. Moreover, it seems that concentration of neuro-development factor significantly depends on severity of romantic feelings. It appears that oxytocin and other neuro-modulators which are chemically related to romantic love such as vasopressin are specifically associated with bonding and attachments. Both of them are produced by hypothalamus that are released and stored in pituitary. This is done in order to get into the blood. Occurrence of these events is more important especially at the time of orgasm in both sexes and also during birth and breastfeeding among women. In men, vasopressin is also associated with their social behavior especially it has significant effect on their aggressive behavior. During the stage that affection and intensive romantic love occur, the concentration of both neuro-modulators increase and the receptors of them are distributed in many parts of the brain stem. These receptors are activated during romantic love. In a study (Bartels, 2000), the brain of the people who were truly, deeply and strongly involved in love was examined in two states: once when watching their lover's photos and the other when watching friends photo (of the opposite sex).

Watching images of the beloved in compared with friends was accompanied with increased activity in insula, the anterior cingulated cortex and the areas which were related to positive feelings, attention to personal emotions, attention to emotional states of social partners and even happiness resulted from opiate materials. Also, observing the images of the beloved is related to inactivation of posterior cingulate cortex, amygdale, right prefrontal and parietal cortex, middle temporal cortex and the areas which are related to sadness, fear, aggression and depression. Brain areas which show distinct patterns of activity did not overlap with active areas during sexual arousal and watching images of romantic partners. However, the early understanding of neuro-chemical substrates of love and interest indicates that biological factors help to this sexual difference. Most of neuro-chemical materials which control mammals dependency specially oxytocin, vasopressin and dopamine also control sexual behaviors. These neuro-chemical materials often show patterns of sexual and hormonal functions. For instance, there are more oxytocin brain circuits in female rats than male ones. Perhaps this is due to the ease of caring behaviors related to oxytocin. Oxytocin is combined with estrogen and regulates sexual receptivity of female rats (Panksepp, 1998). In humans, oxytocin rate is more in women rather than men during sexual activity and in some women there is a correlation between release of oxytocin and orgasm intensity. These findings about areas of sexual desire – relationship between love and desire – are influenced by oxytocin relation and gender roles in these trends. Furthermore, this fact that sometimes women are interested in similar sex is because that they fall in love with their female friends.
Figure 2. Neurotransmitters involved in the processes of romantic love

 Emotional states relate to other sub-systems activities of brain.

CONCLUSION

Romantic Love is a controversial and interesting subject for cognitive researchers and theorists. Of course, there is discordance in some issues. The aim of this study is to investigate systemic emotional, behavioral, and cognitive mechanisms in rehabilitation of romantic love neuro-cognitive processes. Previous researches show that scientific investing should be in the right direction to expand understanding of this significant personal phenomenon. Therefore, it can be used as a solution in emotion rehabilitation. Romantic love is the ability to change the neuro-cognitive processes used as a factor in social cognitive rehabilitation. Neuro-cognitive assessments of romantic love help to better neuro-biological understanding of this complex feeling and stimulated activity pattern is special here and involves a group of different emotions. Multi-dimensional nature of it adds to the complexity of studies so it involves more integration of several fields for assessing. Today, assessment of cognitive, emotional, sensual and behavioral components done in previous studies and related researches with romantic love does not seem enough and need more investigations with human
cognitive evolution more than ever. Attention to social effects and its cognition require manifestation role and evolution of new components. Identification of emotional, behavioral and cognitive processes provides the richest experiences of romantic love to the functional systems of the brain. The perception of this complex feeling create uplifting, motivation, change and evolution of behavior in human. Ability of complex feelings in extensive cortical areas is related to different brain active patterns among different persons and situations. Powerful role of romantic love is activation of involuntary cortical circuits which can create compliance or change which are the bases of feeling rehabilitation. In current study, we tried to briefly express neuro-cognitive theories and systems in the broad field of therapeutic advances, methodological and theoretical affairs. Hope that interested researchers pay more attention to assessments of romantic love neural correlates.

REFERENCES


